



बिलासपुर विश्वविद्यालय शिक्षण विभाग, बिलासपुर (छ.ग.)
में “माइक्रोबायोलॉजी एण्ड बायोइन्फॉरमेटिक्स विभाग” में
एम.एससी. माइक्रोबायोलॉजी एण्ड बायोइन्फॉरमेटिक्स कोर्स के अंतर्गत
सत्र 2016-17 में नियमित छात्रों के लिए लागू

सेमेस्टर पाठ्यक्रम



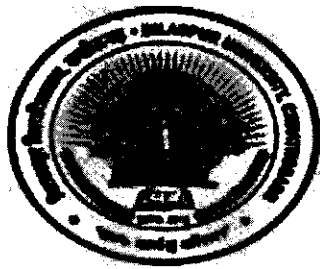
एम.एससी. माइक्रोबायोलॉजी एण्ड बायोइन्फॉरमेटिक्स
M.Sc. Microbiology and Bioinformatics

बिलासपुर विश्वविद्यालय, बिलासपुर (छ.ग.)

पुराना हाईकोर्ट भवन, गांधी चौक, बिलासपुर (छ.ग.) 495001,
फोन : 07752-220031, 220032, 220033 फैक्स 07752-260294,
ई-मेल : bilaspur.university2012@gmail.com,
वेबसाईट : www.bilaspuruniversity.ac.in

DEPARTMENT OF MICROBIOLOGY AND BIOINFORMATICS

M.Sc. Microbiology and Bioinformatics



BILASPUR UNIVERSITY

**Old High Court Bhavan, Near Gandhi Chowk
Bilaspur (C.G) - 495001**

**Department of Microbiology and Bioinformatics
Bilaspur University, Bilaspur**

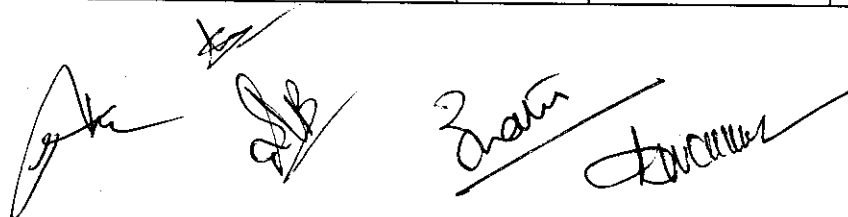
M.Sc. Microbiology and Bioinformatics

First Semester

Course Code	Course Category	Course Name	Lectures	Credits	Maximum Marks		
					CIA	External	Total
MB 101	HC	General Microbiology	60	5	25	75	100
MB-102	HC	Bioinstrumentation and Biostatistics	60	5	25	75	100
MB-103	HC	Virology, Mycology and Phycology	60	5	25	75	100
MB-104	HC	Introduction to Bioinformatics	60	5	25	75	100
MB-105	HC	General Microbiology, Bioinstrumentation and Biostatistics Lab	60	2.5	12.5	37.5	50
MB-106	HC	Virology, Mycology, Phycology and Bioinformatics Lab	60	2.5	12.5	37.5	50
			Total	25	Total		500

Second Semester

Course Code	Course Category	Course Name	Lectures	Credits	Maximum Marks		
					CIA	External	Total
MB-201	HC	Biochemistry and Microbial Physiology	60	5	25	75	100
MB-202	HC	Environmental Microbiology	60	5	25	75	100
MB-203	HC	Bioinformatics Databases	60	5	25	75	100
MB-204	HC	Biomolecules and Enzyme Technology	60	5	25	75	100
MB-205	HC	Biochemistry, Microbial Physiology and Environmental Microbiology Lab	60	2.5	12.5	37.5	50
MB-206	HC	Bioinformatics Databases, Biomolecules and Enzyme Technology Lab	60	2.5	12.5	37.5	50
			Total	25	Total		500

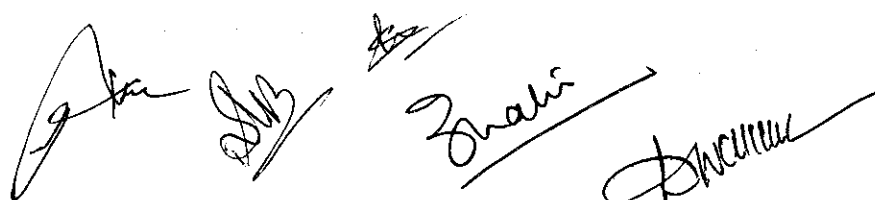


Third Semester

Course Code	Course Category	Course Name	Lectures	Credits	Maximum Marks		
					CIA	External	Total
MB-301	HC	Microbial Genetics and Molecular Biology	60	5	25	75	100
MB-302	HC	Genetic Engineering	60	5	25	75	100
MB-303	HC	Immunology	60	5	25	75	100
MB-304	HC	Bioinformatics and Sequence Analysis	60	5	25	75	100
MB-305	HC	Microbial Genetics, Molecular Biology and Genetic Engineering Lab	60	2.5	12.5	37.5	50
MB-306	HC	Immunology and Sequence Analysis Lab	60	2.5	12.5	37.5	50
			Total	25	Total		500

Fourth Semester

Course Code	Course Category	Course Name	Lectures	Credits	Maximum Marks		
					CIA	External	Total
MB-401	HC	Industrial Microbiology	60	5	25	75	100
MB-402	HC	Programming in PERL	60	5	25	75	100
MB-403	SC-1	Agricultural Microbiology	60	5	25	75	100
	SC-2	Fermentation Technology					
	SC-3	Introduction to Computers, Internet, Programming Languages and Data Structures					
	SC-4	Medical Microbiology					
	SC-5	Drug Designing, Intellectual Property Rights and Patent Laws					
	SC-6	Food Microbiology					
MB-404	HC	Industrial Microbiology and Programming in PERL Lab	60	2.5	12.5	37.5	50
MB-405	HC	Lab on Major Elective	60	2.5	12.5	37.5	50
MB-406	Project Work/ Dissertation	Project Work/ Dissertation	-	5	25	75	100
			Total	25	Total		500



COURSE FRAMEWORK

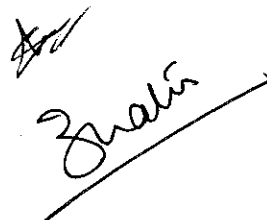
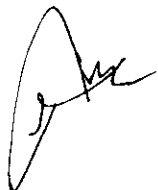
Course categories offered in the curriculum

There shall be three categories of courses:

- a. **HC Core papers:** These papers are compulsory for students.
- b. **SC Elective and Choice Based Paper (MB-403):** Students need to select any one paper from SC-1 to SC-6 in IV Semester.
- c. **Project Work / Dissertation (MB-406):** Students has to carry out a dissertation/ project work in the IV semester.

Each theory paper will be of 100 marks (25 marks will be on internal assessment and 75 marks will be on external assessment). The internal assessment will encompass three tests of 10 marks each. The best out of two will be considered. There will be an assignment for each paper for which a writeup is to be submitted. The writeup should not be less than 15-20 pages. The student will be presenting his topic of assignment in form of PowerPoint presentation. There will be 5 marks for writeup and presentation.

The practicals for each lab course will be of 50 marks (12.5 marks will be of internal assessment and 37.5 marks will be for practical examination). The internal assessment for practicals will be based on regularity and performance during the complete semester.



M. Sc. Microbiology and Bioinformatics I Semester

MB- 101: GENERAL MICROBIOLOGY

UNIT –I

History and scope of Microbiology: Contributions of eminent scientists in the field of Microbiology. Introduction of prokaryotes. Natural System of Classification, Binomial Nomenclature, International code of Nomenclature of Prokaryotes. Taxon, Species, Strain. Criteria used for Classification – Three Domain Classification, Classification of bacteria according to Bergey's Manual of Determinative Bacteriology. Recent trends in microbial taxonomy: Chemotaxonomy, Molecular methods, Numerical taxonomy, Genetic methods in taxonomy, Serological methods and Taxonomy based on Ecology.

UNIT –II

Sterilization techniques: physical and chemical methods. **Isolation media and Preservation:** Culture media, Isolation and culture techniques. Pure culture techniques and preservation of cultures.

UNIT – III

Morphology and ultra structure of bacteria: Morphological types- shape, size and arrangements. Cell wall of Eubacteria and Archaeobacteria. Cell Membrane - structure, composition and properties. Antigenic properties: structure and function of capsule, flagella, pili and cilia. Cytoplasmic inclusions. Characteristic features and economic importance of major groups of Eubacteria and Archea.

UNIT – IV

Nutrition and growth in Bacteria: Nutritional types of bacteria, Physiological requirements (micro and macro nutrients). Cultural characteristics of bacteria, Cultivation of bacteria: aerobic anaerobic, batch, continuous and synchronous cultures. Bacterial growth - growth kinetics, growth rate and generation time, growth curve, factors affecting growth, Nutritional uptake (bacterial transport system).

UNIT-V

Reproduction in bacteria – Binary fission, endospore formation and cell wall synthesis (peptidoglycan synthesis). Recombination in bacteria- Conjugation, Transformation and Transduction.

Recommended Text Books

- Singh, R.P. General Microbiology. Kalyani Publishers, New Delhi (2007).
- Aneja, K.R. Experiments in Microbiology, Plant pathology and Biotechnology, Fourth edition, NewAge International publishers.
- Dubey, R.C. and Maheshwary, D.K. Text book of Microbiology. S.chand and company (1999).
- Powar, C.B. and Dagainawal, H.F. General Microbiology. Vol-I and Vol- II, Himalaya Publishing House.
- Chakraborty P. A Textbook Of Microbiology. New central book Agency (2005).

Reference Books

- Prescott, M.J., Harley, J.P. and Klein, D.A. Microbiology. 5th Edition WCB Mc GrawHill, New York, (2002).
- Tortora, G.J., Funke, B.R. and Case, C.L. Microbiology: An Introduction. Pearson Education, Singapore, (2004).
- Alcom, I.E. Fundamentals of Microbiology. VI Edition, Jones and Bartlett Publishers. Sudbury. Massachusetts, (2001).
- Black J.G. Microbiology-Principles and Explorations. John Wiley & Sons Inc. New York, (2002).

LAB

1. Introduction to good laboratory practices and sterilization techniques and preparation of different nutrient media's – Liquid and Solid media- minimal, complex and differential media.
2. Isolation of bacteria from air, water and soil.
3. Morphological characteristics of bacteria- staining (simple and differential staining techniques).
4. Bacterial culture techniques- Broth culture, Pure culture techniques.
5. Measurement of bacterial population by turbidimetry and colony counting by serial dilution of samples.
6. Bacterial growth curve.
7. Antibiotic sensitivity tests- disc method.
8. Preservation of pure cultures: slant preparation, water stock and glycerol stock.
9. Biochemical tests for bacterial identification.

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M. Sc. Microbiology and Bioinformatics I Semester

MB-102: BIOINSTRUMENTATION AND BIOSTATISTICS

UNIT -I

Microscopy: Principles, Types of Microscopes, Construction and Working principles. Light microscopy-simple dissection microscope, Compound microscopy, (Bright field, Dark field, Phase contrast and fluorescence microscopy) and stereomicroscopy. Confocal microscopy. Electron microscopy – Principle, construction and mode of operation of scanning and transmission electron microscopy and their limitations. Preparation of specimens for electron microscopic studies (Ultra thin sectioning, negative staining, shadow casting and freeze etching).

UNIT-II

Spectrophotometry: Principles and techniques of colorimetry and Beer's Lambert's law. Spectrophotometry, Spectrofluorimetry, Turbidometry, Flame and Atomic absorption Spectrophotometer.

Electrophoresis: Principles and working, types of electrophoresis, Separation of nucleic acids (DNA and RNA), separation of proteins (native and SDS-PAGE, 2-D gel electrophoresis, Hybridization –Western blot, Northern blot, Southern blot and North-western blot.

UNIT-III

Centrifugation: Basic Principles, Types of centrifugation, centrifugation methods and accessories used for colloidal nature of particles, sedimentation velocity, sedimentation equilibrium and cell fractionation methods.

UNIT-IV

Chromatography: Principle of separation, Types- liquid-liquid, thin layer, adsorption, gas liquid, ion exchange, affinity and HPLC –Principles of each type, instrumentation and accessories-detection methods and systems qualitative and quantitative aspects –applications.

UNIT-V

Biostatistics- Data, Types of data, central tendency of the given data –Mean, Mode, Median, standard error, standard deviation, t-Test of significance, F-test, Chi-square test. Analysis of variance –one way and two way.



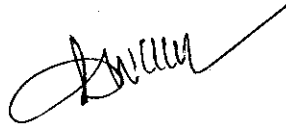
Fundamentals of computers – Block diagram of computer (input and output devices) – History – Generations – Memory devices – Advantages and Limitations of Computers – Comparison of different operating systems DOS, Windows NT & XP, Application Software's.

Recommended Text Books

- Wilson & Walker. Principles and Techniques in Practical Biochemistry. 5th Edition Cambridge University Press (2000).
- Khan I A and Khan I A. Fundamentals of Biostatistics, Ukaaz Publications, (1994).
- Murphy D.B. Fundamental of Light Microscopy & Electron Imaging. 1st Edition. Wiley-Liss. (2001).
- Beckner, W.M., Kleinsmith L.J and Hardin J. The world of cell. IV edition Benjamin/Cummings (2000).

LAB

1. Study of simple and compound microscopes and their handling.
2. Absorption spectra –UV-Visible.
3. Paper chromatography of amino acids and carbohydrates.
4. Thin layer chromatography.
5. Ion-exchange chromatography.
6. SDS Gel electrophoresis.
7. Agarose Gel electrophoresis.
8. Handling and organization of data.
9. Calculation of mean of length of 20 Ashoka leaves.
10. Calculation of mode of length of 20 Ashoka leaves.
11. Calculation of median of length of 20 Ashoka leaves.
12. To perform t- test of significance.
13. To perform χ^2 test on given data.



4




M. Sc. Microbiology and Bioinformatics I Semester

MB-103: VIROLOGY, MYCOLOGY AND PHYCOLOGY

UNIT-I

Structure, Culture and Identification of Viruses: Nature and ultrastructure of viruses. Viral related agents: Viroids and Prions. Cultivation of viruses in embryonated eggs, experimental animals and Cell culture. Serological methods for Haemagglutination, complement fixation, IFA, ELISA, RIA.

UNIT-II

Virology: Classification and nomenclature of animal viruses. Life cycles of Herpes, adeno and SV 40, orthomyxovirus, HIV and adenovirus. General idea of plant viruses, Mode of transmission, and their pathological significance, TMV and CMV. Bacteriophage: Classification, morphology and ultrastructure of bacteriophages with special reference to T-phages. ϕ X174, M13 and Mu phage. Lytic and lysogenic cycles of bacteriophages.

UNIT-III

General characteristics of fungi: structure and organization of fungus. Reproduction in fungi- Vegetative, asexual and sexual reproduction in fungi. Nutrition and metabolism in fungi. Fungal culture media. Fungi as food- mushrooms. Mycotoxins.

UNIT - IV

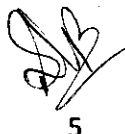
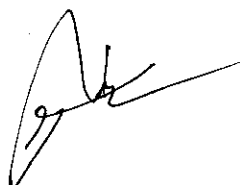
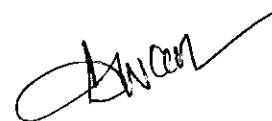
Mycology: Myxomycetes, Ascomycetes, Basidiomycetes and imperfect fungi. Mycorrhiza. Morphological features of *Alternaria*, *Curvularia*, *Helminthosporium*, *Fusarium* *Microsporium*. Lichens: Their types and biological significance.

UNIT - V

Phycology: Distribution of algae. Classification of algae, thallus organization in algae, reproduction in algae. Brief account of Chlorophyta, Bacillariophyta, Phaeophyta, Rhodophyta. Algal ecology and algal biotechnology.

Recommended Text Books

- Pelezar M., Chan E.C.S. and Krieg, N.R. Microbiology. Tata Mc Grew Hill Publishing Co. Ltd., New Delhi.
- Stainier R.V., Ingraham, J.L., Wheelis, M.L. and Painter P.R. The Microbial World. Printice-Hall of India (Pvt.) Ltd., New Delhi.
- Alexopoulos, C.J., Mims, C.W. and Blackwel, M, Introductory Mycology. John Wiley, New York.
- Mehrotra, R.S. and K.R. Aneja An Introduction to Mycology. New Age International Press, New Delhi.
- Webster, J. Introduction to fungi. Cambridge University Press. Cambridge, U.K. (1985).
- Bessey E.A. Morphology and Taxonomy of fungi. Vikas Publishing House Pvt. Ltd., New Delhi.


5

LAB

1. Isolation of bacteriophages from sewage.
2. Study of symptoms of viral infection in plants.
3. Mechanisms of Transfer of virus in plants.
4. Study of cytopathic effect of virus in egg.
5. Calculate the bacteriophage number in a sewage sample with the help of PFU.
6. Isolation of storage fungi.
7. Study of morphological characteristics of Aspergillus, Penicillium, Alternaria, Mucor, Rhizopus, Curvularia, Fusarium, Helminthosporium, Fusarium and Yeast.
8. Study of morphological characteristics of edible mushroom.
9. Quantitate the ethanol production by yeast.
10. Isolation of endophytic fungus.
11. Morphological features of Nostoc.

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M. Sc. Microbiology and Bioinformatics I Semester

MB- 104: INTRODUCTION TO BIOINFORMATICS

UNIT -I

Bioinformatics concepts: Aim and branches of Bioinformatics, Application of Bioinformatics. Role of internet and www in bioinformatics. Basic bimolecular concepts: Protein and amino acid, DNA & RNA, Sequence, structure and function. Forms of biological information. Types of Nucleotide Sequence: Genomic DNA, Complementary DNA (cDNA), Recombinant DNA (rDNA), Expressed sequence tags (ESTs), Genomic survey sequences (GSSs). DNA sequencing methods: Basic and Automated DNA sequencing, DNA sequencing by capillary array and electrophoresis, Gene expression data.

UNIT -II

Bioinformatics Resources: NCBI, EBI, ExPASy, RCSB and DDBJ: The knowledge of databases and bioinformatics tools available at these resources, organization of databases: data contents, purpose and utility. Open access bibliographic resources and literature databases: PubMed, BioMed Central, Public Library of Sciences (PloS), CiteXplore.

UNIT -III

Sequence databases: Nucleic acid sequence databases: GenBank, EMBL, DDBJ; Protein sequence databases: Uniprot-KB: SWISS-PROT, TrEMBL, UniParc; Structure Databases: PDB, NDB, PubChem, ChemBank. Sequence file formats: Various file formats for biomolecular sequences: GenBank, FASTA, GCG, MSF etc. Protein and nucleic acid properties: Proteomics tools at the ExPASy server, GCG utilities and EMBOSS, Computation of various parameters.

UNIT -IV

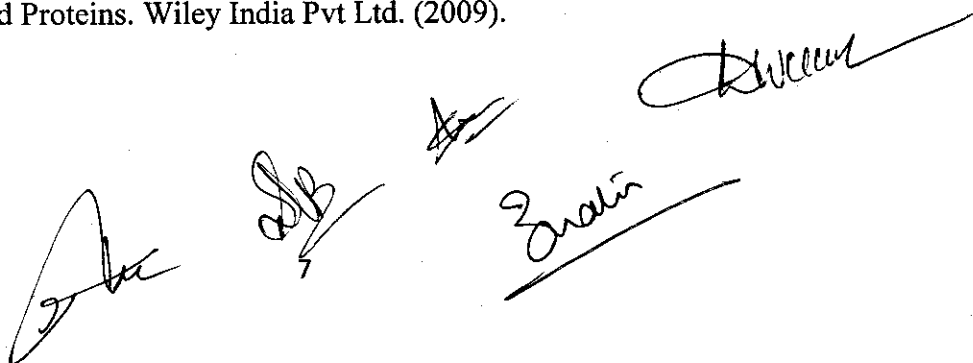
Sequence Analysis: Basic concepts of sequence similarity, identity and homology, definitions of homologues, orthologues, paralogues and xenologues Scoring matrices: basic concept of a scoring matrix, Matrices for nucleic acid and proteins sequences, PAM and BLOSUM series. matrix derivation methods and principles.

UNIT -V

Sequence alignment: Measurement of sequence similarity; Similarity and homology. Pairwise sequence alignment: Basic concepts of sequence alignment, Needleman and Wunsch, Smith and Waterman algorithms for pairwise alignments, gap penalties, use of pairwise alignments for analysis of Nucleic acid and protein sequences and interpretation of results.

Recommended Text Books

- Mount D., Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor Laboratory Press, New York. (2004).
- Baxevanis, A.D. and Francis Ouellette, B.F., Bioinformatics- A Practical Guide to the Analysis of Genes and Proteins. Wiley India Pvt Ltd. (2009).



Reference Books

- Teresa K. Attwood, David J. Parry-Smith, Introduction to Bioinformatics. Pearson Education. (1999).
- Jean-michel Claverie Cedric Notredame. Bioinformatics for Dummies. Publisher: Dummies (2007).

LAB

1. Entrez and Literature Searches
 - a. PubMed
 - b. PubMed central
 - c. OMIM / OMIA
 - d. Citation matcher
2. SRS of Biological Databases
 - a. Nucleotide/ Genome Databases.
 - b. Protein Sequence Database.
 - c. Structure databases.
 - d. Protein Pattern Databases
3. File format conversion
 - a. FmtSeq
 - b. ReadSeq
 - c. Sequence manipulation Suite
4. Sequence Analysis
 - a. Dot Plot
 - b. Pairwise alignment
 - c. Multiple Sequence Alignment
5. Softwares
 - a. BioEdit.
 - b. GeneDoc
 - c. ClustalW / X, MEGA, MEME
6. Visualization Tool
 - a. RasMol
 - b. Cn3D
 - c. PyMol

DW Allen

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M. Sc. Microbiology and Bioinformatics II Semester

MB-201: BIOCHEMISTRY AND MICROBIAL PHYSIOLOGY

UNIT – I

Basic aspects of bioenergetics: First and second law of thermodynamics. Concept of free energy, ATP as a high energy compound. Oxidative photophosphorylation. Detail classification, structure and functions of carbohydrate, protein and lipids.

UNIT – II

Major nutritional types of microorganisms: Autotrophs, Heterotrophs, Chemotrophs, Phototrophs, Lithotrophs and Organotrophs. Physiology and importance of specialized groups of microorganisms: psychrophilic, thermophilic, osmophilic, xerophilic, halophilic, acidophilic, Barophiles microorganisms. Methanogens and methylotrophs. Specific metabolic pathways for generation of hydrogen and methane.

UNIT - III

Nature and expression of microbial growth: Growth phase, growth curve of bacterial population and other microorganisms. Generation time. Measurement of growth: cell mass, cell number and cell constituents. Bacterial growth in batch and continuous cultures, chemostats and turbidostats, synchronous growth. Anaerobic culturing of bacteria.

UNIT – IV

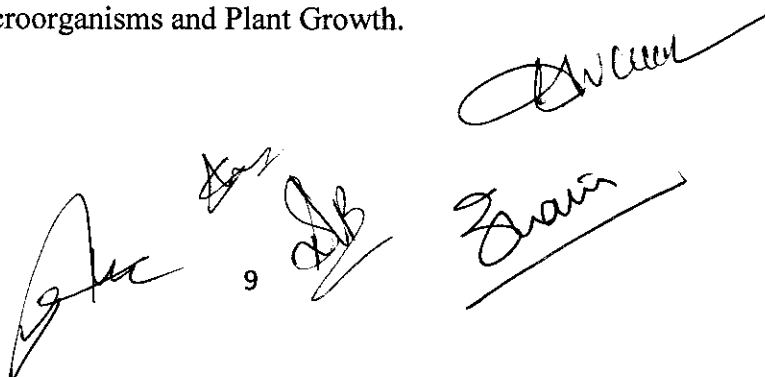
Photosynthetic microorganisms: classification and characterization of Photosynthetic microorganisms. General account of photosynthesis and photometabolism. Fermentation of carbohydrates. Fixation of molecular Nitrogen. Nitrification and denitrification. Microbial leaching of minerals.

UNIT – V

Factor affecting growth of microorganisms: Mechanism of antibacterial action. Antibiotics and drugs affecting cell wall and cell membrane, inhibition of DNA synthesis and protein synthesis. Drug resistance in bacteria. Radiation sensitivity.

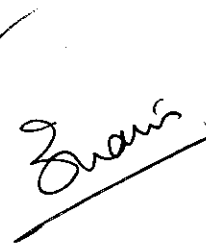
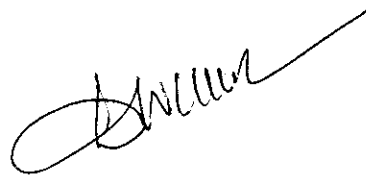
Recommended Text Books

- Stanier, Ingraham, Wheelis and Painter. The Microbial world. Mc Millan Educational Ltd., London.
- Moat and Foster, Microbial Physiology. Wiley.
- Umbreit. Essentials of Bacterial Physiology.
- Skokatch. Bacterial Physiology and Metabolism.
- Kushner, D.J. Microbial life in Extreme Environments. Academic Press.
- Pawar. C.B. Cell Biology.
- Sturart. Harris and Harris. The control of Antibiotic Resistance in Bacteria.
- Franklin and Snow, Biochemistry of Antimicrobial Action. Chapman and Hall, New York.
- Philipp. G. Manual of Methods for General Bacteriology.
- David T. Plummer. An Introduction to Practical Biochemistry.
- Subba Rao. N.S. Soil Microorganisms and Plant Growth.

The bottom of the page features several handwritten signatures and initials. From left to right, there is a large signature that appears to be 'S. K.', a smaller signature 'S. B.', and a large signature 'S. Rao'. A small number '9' is written in the center between the 'S. B.' and 'S. Rao' signatures.

LAB

1. Study of morphological characteristics of Nostoc.
2. Study of oligodynamic effect of metals on microorganisms.
3. Study of effect of UV radiations on the growth of fungus.
4. Antibiotic sensitivity test (disk diffusion).
5. Study of effect of salt concentration on microorganism.
6. Study of effect of sugar concentration on microorganism.
7. Isolation of keratinophiles by baiting technique.
8. Isolation of Rhizobium from root nodules.
9. Study of bacterial growth curve by spectrophotometric method.
10. Study the anaerobic gas pack jar for cultivation of anaerobes.
11. Biochemical estimations of carbohydrate, protein and lipids.



M. Sc. Microbiology and Bioinformatics II Semester

MB-202: ENVIRONMENTAL MICROBIOLOGY

UNIT -I

Aeromicrobiology: Bioaerosol, Droplet Nuclei. Phylloplane and Phyllosphere microflora. Air borne microorganisms and their significance in human health and plant disease development. Techniques for analysis of air borne microorganisms- The settling plate technique, slit type sampler, liquid impinger, sieve sampler, Anderson's sampler, cascade sampler; Filtration methods. Control of air borne microbes.

UNIT -II

Soil Microbiology: Classification of soil - physical and chemical characteristics, Soil as a habitat for Microbial Growth. Microbial Interactions. Rhizosphere, Rhizoplane. Role of microorganisms in mineral cycling and soil fertility. Biodegradation of organic compounds in soil.

UNIT -III

Aquatic Microbiology: Microbiology of Fresh water (pond and lakes) and Marine water (estuaries, deep sea, hydrothermal vents) Ecosystem. Potability of water, Microbial assesment of water quality. Methods of purification of water. Waste water (sewage) treatment.

UNIT -IV

Biowaste Management and Treatment: Treatment of dairy and Industrial effluent. Solid waste treatment and management. Use of waste for production of food (Mushroom), Biofertilizer (Compost) and biofuel (biogas and ethanol). Biodegradation and Xenobiotics- Plastic, oil spills, and oil refinery waste.

UNIT -V

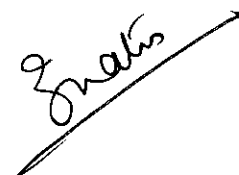
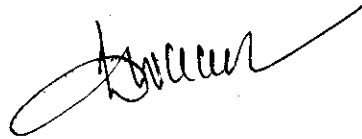
Microbial activities: Biodeterioration of paper, pulp textile and paints, Biomagnification, Bioaugmentation, Biomining and bioleaching, Biodiesel production from Jatropa, Biomonitoring.

Recommended Text books

- Medigan, M.T., Martinko, J. M. and Parker, J. Brock Biology of Microorganisms. Pearson Education Inc. , New York
- Alexander, M. John. Microbial ecology. Wiley & Sons, Inc., New York.
- Alexander, M. John. Introduction to soil microbiology. Wiley & Sons Inc., New York.
- Barker, KH. and Herson, D.S. Bioremediation. Mc Craw Hill Inc., New York.

LAB

1. Isolation and enumeration of microorganism from air samples by settle plate technique.
2. Isolation and enumeration of microorganism from water samples by Bait Method.
3. Isolation and enumeration of microorganism from soil samples by serial dilution technique.
4. Determination of BOD of water (Raw/ Treated /Sewage).
5. Detection of Dissolved Oxygen (DO).
6. IMViC Test.
7. Multiple fermentation tube tests for Coliforms.
8. Isolation of cellulase producing microorganisms from soil.
9. Study of antagonism.



M. Sc. Microbiology and Bioinformatics II Semester

MB-203: BIOINFORMATICS DATABASES

UNIT –I

Introduction to Bioinformatics data and databases: Types of Biological data:- Genomic DNA, Complementary DNA (cDNA), Recombinant DNA (rDNA), Expressed sequence tags (ESTs), Genomic survey sequences (GSSs). Primary Databases: - GenBank, EMBL, DDBJ. Composite Databases:-NRDB, UniProt, Literature Databases:- Open access and open sources, PubMed, PLoS, Biomed Central.

UNIT –II

Genome Databases: Viral genome database (ICTVdb, VirGen), Bacterial Genomes database (Genomes Online Database – GOLD, Microbial Genome Database - MGD), Organism specific Genome database (OMIM / OMIA, SGD, WormBase, PlasmoDB, FlyBase, TAIR), and Genome Browsers (Ensembl, VEGA genome browser, NCBI-NCBI map viewer, KEGG, MIPS, UCSC Genome Browser).

UNIT –III

Sequence Databases: Nucleotide sequence Databases (GenBank, EMBL and DDBJ). Protein sequences Databases (Swiss-ProtProt, TrEMBL, UniProt, UniProt Knowledgebase – UniProtKB, UniProt Archive –UniParc, UniProt. Reference Clusters –UniRef, UniProt Metagenomic and Environmental Sequences –UniMES. Sequence motifs Databases – Prosite, ProDom, Pfam, InterPro. Sequence file formats –GenBank, FASTA, PIR, ALN/ClustalW2, GCG/MSF.

UNIT –IV

Structure and Derived databases: Primary structure databases (Protein Data Bank –PDB, Cambridge Structural Database –CSD, Molecular Modeling Database –MMDB). Secondary structure databases, Structural Classification of Proteins –SCOP, Class Architecture Topology Homology –CATH, Families of Structurally Similar Proteins –FSSP, Catalytic Site Atlas –CSA. Molecular functions/Enzymatic catalysis databases (KEGG ENZYME database, BRENDA).

UNIT –V

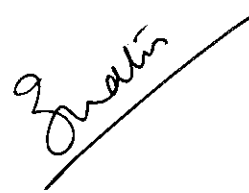
Bioinformatics Database search engines: Text-based search engines (Entrez, SRS, DBGET /LinkDB). Sequence similarity based search engines (BLAST and FASTA). Motif-based search engines (ScanPrositeScanProsite and eMOTIF). Structure similarity based search engines (VAST and DALI). Proteomics tools at the ExpASY server, GCG utilities and EMBOSS.

Recommended Text Books

- Mount D., Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor Laboratory Press, New York. (2004).
- Baxevanis, A.D. and Francis Ouellette, B.F., Bioinformatics- A Practical Guide to the Analysis of Genes and Proteins. Wiley India Pvt Ltd. (2009).
- Teresa K. Attwood, David J. Parry-Smith. Introduction to Bioinformatics. Pearson Education. (1999).

LAB

1. Bioinformatics Resources: NCBI, EBI, DDBJ, RCSB and ExPASy.
2. Open access bibliographic resources and literature databases
 - a. PubMed.
 - b. BioMed Central.
 - c. Public Library of Sciences (PLOS).
 - d. CiteXplore.
3. Bioinformatics Resources at the species level
 - a. ICTV Database.
 - b. AVIS.
 - c. VirGen.
 - d. Viral genomes at NCBI.
4. Sequence databases:
 - a. Nucleic acid sequence databases: GenBank, EMBL and DDBJ.
 - b. Protein sequence databases: Uniprot-KB: SWISS-PROT, TrEMBL and UniParc.
 - c. Repositories for high throughput genomic sequences: EST, STS and GSS.
 - d. Genome Databases at NCBI, EBI, TIGR and SANGER.
5. Structure Databases: PDB, NDB, PubChem, ChemBank, FSSP and DSSP.
6. Derived Databases: InterPro, Prosite, Pfam and ProDom.
7. Sequence file formats: GenBank, FASTA, GCG and MSF.
8. Protein and nucleic acid properties: Proteomics tools at the ExPASy server, GCG utilities and EMBOSS.



M. Sc. Microbiology and Bioinformatics II Semester

MB-204: BIOMOLECULES AND ENZYME TECHNOLOGY

UNIT- I

Introduction to enzymes: Enzyme classification and nomenclature, characteristics of enzymes. Mode of action and kinetics of enzyme catalyzed reactions (K_m and V_{max}). Types and Mechanism of enzyme inhibition, Biotechnological importance of enzymes.

UNIT – II

Microbial sources of enzymes: Primary and secondary screening of microorganisms for enzyme production. Qualitative and quantitative assay of enzyme activity: Amylases, Cellulases, Hemicellulases, Proteases. Natural and synthetic substrates for enzyme assay. Enzymes units.

UNIT – III

Methods of enzyme production: Submerged and Solid State Fermentation (SSF). Important parameters in enzyme production. Enzyme purification Techniques- Precipitation, chromatographic separation-gel filtration, anion and cation exchange, zymography.

UNIT-IV

Techniques used in characterization of enzymes: Determination of molecular weight (SDS PAGE, Gel filtration), Isoelectric point, pH & temperature optima and stability, Inhibition pattern, Product analysis of enzyme action using TLC, HPLC, GC, MS and MALDI-TOF.

UNIT- V

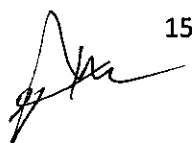

Molecular biology of enzymes: Amino acid sequencing, structure and function relationship. Protein engineering & directed evolution. Cloning and over expression of microbial enzymes in heterologous host.

Recommended Text Books

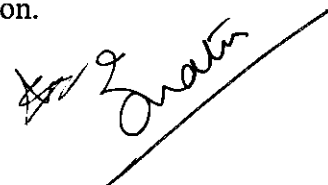
- Berg J M, Tymoczko J L, Stryer L., Biochemistry. 6th Edition. Freeman (2006).
- Prakash Singh Bisen, Anjana Sharma, Introduction to Instrumentation in Life Sciences. Taylor and Francis, (2012).
- James Bailey and David Ollis, Fundamentals of Biochemical Engineering, 2nd edition, McGraw-Hill, (1986).
- Casida LE, Industrial Microbiology, J. Wiley, (1968).
- Chisti. Y. Encyclopedia of Bioprocess Technology, Vol-5, John Wiley and Sons, New York.
- Michael L. Shuler and Fikret Kargi. Bioprocess Engineering: Basic Concepts, 2nd Edition. Prentice Hall. (2001).

LAB

1. To isolate industrially important enzyme producers from soil.
2. Qualitative and Quantitative assay of the selected enzyme.
3. Optimization of the enzyme production.
4. Scaling up of the enzyme production in Laboratory fermentor.
5. Analysis of substrate utilization and product formation.
6. Ammonium sulphate precipitation for enzyme concentration.
7. Column Chromatography for purification.
8. SDS PAGE for enzyme purification.



15



M. Sc. Microbiology and Bioinformatics III Semester

MB-301: MICROBIAL GENETICS AND MOLECULAR BIOLOGY

UNIT-I

Microbial Genetics: Definition and scope of Genetics. Premendelian and Mendelian genetics. Organization of genetic material in bacteria, Gene transfer mechanisms in bacteria – Conjugation, Transduction and Transformation.

UNIT-II

Fungal genetics: Features and consequences of heterothallism, homothallism, mating types, Vegetative incompatibility, Polyploidy, and aneuploidy. Neurospora –Tetrad analysis and linkage detection. Two point and three point crosses –Induction of mutation –Mitotic recombination in Neurospora –Transposable elements –Gene conversion.

UNIT-III

Organization and process of Eukaryotic genome: components of eukaryotic chromatin, DNA super coiling, satellite DNA, Prokaryotic and Eukaryotic replication, Mechanism of replication, Enzymes and necessary proteins involved, Telomers, telomerase and end replication, DNA Repair-Mismatch, Base-excision, Nucleotide excision and Direct repair, DNA recombination –Homologous site specific and DNA transposition.

UNIT-IV

Transcription: Prokaryotic and Eukaryotic Transcription –RNA polymerase –general and specific transcription factors, regulatory elements-mechanism of transcription regulation. Transcription termination. Post transcriptional modification – 5' cap formation -3' end processing and polyadenylation-splicing, editing, nuclear export of mRNA-mRNA stability.

UNIT-V

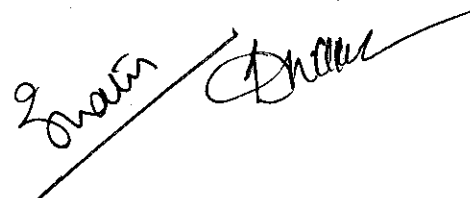
Translation: Genetic code –Prokaryotic and Eukaryotic Translation, Translation machinery, Mechanism of initiation –elongation and termination
Regulation of gene expression, operon concept, catabolite repression, positive and negative regulation, inducers and co-repressors, lac operon, ara operon and Tryp Operon.

Recommended Text Books

- Benjamin Lewin. Gene VII, Oxford University Press, (2000).
- Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, Molecular biology of the Cell, 4th Edition. Garland publishing Inc. (2002).
- Darnell, Lodish and Baltimore, Molecular Cell Biology, Scientific American Publishing Inc. (2000).
- Watson. J. D. Baker. T. A, Bell. S. P, Gann. A. Levine. M. Losick. R, Molecular Biology of Gene, 5th Edition. The Benjamin/Cummings Pub. Co. Inc. (2003).
- David Fritfielder, Stanely R. Maloy, Molecular biology and Microbial genetics. 2nd Edition, Jones and Barlett Publishers. (1994).
- Brown T.A., Gene Cloning and DNA analysis. 2nd Edition, ASM press. (2004).
- Sandy Primrose, Principles of Gene Manipulation and Genomics. 7th Ed., Blackwell Publishers. (2006).
- Glick BR and Pasternak JJ, Molecular Biotechnology, 2nd Ed. ASM press. (2003).
- Uldis N. Sniegos, Ronald E. Yasbin. Modern Microbial Genetics. 2nd Edition Wiley-Liss, Inc. (2004).



16



- Russel P J, Essential genetics, Blackwell Science Inc, 2 sub edition, (1987).
- Gardner E J, Simmons M J and Snupstad DP, Principles of genetics, 8th edition John Wiley & Sons, (2006).

LAB

1. Isolation of Plasmid DNA from bacteria.
2. Isolation of Genomic DNA from bacteria.
3. Isolation of RNA from yeast.
4. Quantitative estimation of RNA by orcinol method.
5. Quantitative estimation of DNA by DPA method.
6. Determination of T_m value of DNA.
7. Protein purification by ion exchange chromatography.
8. Protein purification by gel permeation chromatography.
9. Purification of protein by SDS PAGE.

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MB- 302: GENETIC ENGINEERING

UNIT –I

Basic techniques in Genetic Engineering: Isolation and purification of genomic and plasmid DNA. Pulse field gel electrophoresis. Nucleic acid blotting (Southern, Northern and Western blotting). RNase protection assay, *in situ* hybridization. PCR methods and application (RT-PCR, RT-Quantitative PCR). DNA sequencing methods- Maxam and Gilbert method, Sanger's dideoxy method, Automated DNA sequencing, pyrosequencing. Oligonucleotide synthesis, Site-directed mutagenesis: Analysis of genetic variation-Single nucleotide polymorphism, RFLP, RAPD, Restriction mapping, Chromosome mapping and chromosome painting, DNA Chips and Microarray.

UNIT –II

DNA manipulating Enzymes: Nucleases, polynucleotide kinase, DNA Ligase, DNA polymerase I, Klenow fragment, RNA dependent DNA polymerase, Terminal deoxynucleotidyl transferase, poly A Polymerase, alkaline phosphatase, Reverse transcriptase, Restriction endonucleases. **Prokaryotic Host-Vector system:** Vectors (Plasmid, Bacteriophage, Cosmids and Plasmid-Phage) for cloning in Prokaryotic host (*E.coli*), shuttle vectors and expression vectors.

UNIT –III

Recombinant DNA concept and Principles of Cloning: Construction of vector, ligation, infection, transfection and Cloning. Cloning in Yeast, Cloning in Animals System, Cloning in Plant System - Properties of Host, vectors and methods of introduction of foreign DNA in host system.

UNIT –IV

Methods of screening and selection of Recombinant clones: DNA Libraries- development of vectors, construction of genomic and full length cDNA Libraries. Screening libraries with gene probes. Sequence dependent screening- colony hybridization, plaque hybridization, Screening by gain of function, Immunological screening, chromosome walking, studying gene function through protein interactions – two hybrid screening, phage display libraries. Analysis of gene expression based on 17 RNA Polymerase, visible marker gene. Gene silencing.

UNIT –V

Applications and legal issues: Applications of genetic engineering in agriculture, veterinary, industry, Forensic Science and Medicine. Transgenic crops, animals, recombinant enzymes, pharmaceuticals– humulin, somatotropin and somatostatin, Ethical, legal, social and environmental issues.

Recommended Text Books

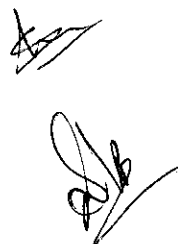
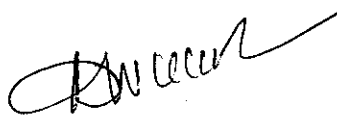
- Singh, R.P. General Microbiology. Kalyani Publishers. New Delhi, (2007).
- Aneja K. et al. Experiments in Microbiology, Plant pathology and Biotechnology by, NewAge International publishers Fourth edition
- Dubey R.C and Maheshwary D.K. Text book of Microbiology. S.Chand and company (1999).

Reference Books

- Benjamin Lewin, Gene VII, Oxford University Press, (2000).
- Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, Molecular biology of the Cell, 4th Edition. Garland publishing Inc, (2002).
- Darnell, Lodish and Baltimore, Molecular Cell Biology, Scientific American Publishing Inc. (2000).
- Watson. J. D. Baker. T. A, Bell. S. P, Gann. A. Levine. M. Losick. R, Molecular Biology of Gene, 5th Edition. The Benjamin/Cummings Pub. Co. Inc. (2003).
- David Frifielder, Stanely R. Maloy, Molecular biology and Microbial genetics. 2nd Edition, Jones and Barlett Publishers. (1994).
- Brown T.A., Gene Cloning and DNA analysis. 2nd Edition, ASM press. (2004).
- Sandy Primrose. Principles of Gene Manipulation and Genomics. 7th Ed., Blackwell Publishers. (2006).
- Glick BR and Pasternak JJ, Molecular Biotechnology, 2nd Ed. ASM press. (2003).
- Uldis N. Streips, Ronald E. Yasbin. Modern Microbial Genetics. 2nd Edition Wiley-Liss, Inc. (2002).
- Russel P J. Essential genetics, Blackwell Science Inc, 2 sub edition, (1987).
- Gardner E J, Simmons M J and Snpustad DP, Principles of genetics, 8th edition John Wiley & Sons, (2006).

LAB

1. Plasmid DNA isolation and quantification.
2. Preparation of competent cells.
3. Transformation of plasmid DNA into *E. coli* cells.
4. Analysis of cloned gene and agarose gel electrophoresis.
5. Bacterial Gene Expression (using Lac promoter system).
6. Restriction Fragment Length Polymorphism analysis.
7. RAPD Fingerprinting (Demonstration).



M. Sc. Microbiology and Bioinformatics III Semester

MB-303: IMMUNOLOGY

UNIT –I

Immune Systems: Cells & Organs of immune System, Anatomical Barriers, Types of Immunities, Antigens- Their properties, specificity, haptens, Bacterial toxins, Immunological tolerance.

UNIT –II

Antigen and Antibody: Structure of antibodies & their types, Theories of antibody formation, Immunological tolerance Mechanisms of antibody & antigen reaction, Serological reactions.

UNIT –III

Immune Reactions: Hypersensitivity and their types, Autoimmune disease. Immunoprophylaxis. Active and passive immunization. Tumor immunology.

UNIT –IV

Immunodeficiency and MHC: Transplantation and Rejection, Primary immunodeficiency, Secondary immunodeficiency, The Complement system, Major Histocompatibility Complex.

UNIT –V

Microbial Immunology: Infection. Immunity against bacteria, fungus and virus. Immunohematology, Immunology of transplantation and malignancy.

Recommended Text Books

- Bernard, Davis B. Dulbecco, Eisen and Ginsberg. Microbiology including immunology and molecular Genetics. 3rd Edition
- Roitt I. Essential Immunology. 10th Ed. Blackwell Science.
- Kuby. Immunology. 4th edition. W. H. Free man & company.
- Ananthanarayan and Paniker. Text book of microbiology. University press. 8th edition

LAB

1. Widal test.
2. RPR test for Syphilis.
3. Blood group determination.
4. Ouchterlony double diffusion test.
5. Immunoelectrophoresis.

